various plants, causing the disintegration of the massive walls. Among such plants *Rhytidophyllum crenulatum* is the most prominent. Attention was next directed to the suburban driveways and country roads in both winter and summer conditions and to the trees that have been planted along their sides. These plantings consist principally of *Ficus religiosa*, *Ficus nitida* (which is commonly known as laurel), *Terminalia Catappa* (popularly called almond), royal poincianas, royal palms, and other well-known ornamental trees of the tropics. The palms are made use of for many purposes; they furnish shade for tobacco, and their leaves are employed for wind-breaks, in the construction of houses, in making coverings for tobacco bales, in making rain-coats, etc.

Allusion was made also to the work of the Agricultural Experiment Station at Santiago de las Vegas and to the agricultural conditions and products of various parts of the island. The speaker also showed views from thinly settled portions of Cuba, giving an idea of the scenery and the character of the indigenous vegetation.

Adjournment followed.

MARSHALL A. HOWE,
Secretary pro tem.

OF INTEREST TO TEACHERS

SOME REFLECTIONS UPON BOTANICAL EDUCATION IN AMERICA

BY W. F. GANONG

In the address with which he welcomed the American Association for the Advancement of Science to Columbia University three years ago, President Butler centered his remarks on a matter of the first scientific and educational importance. He said, in effect, that for a quarter century he had been a close and friendly observer of the progress of the sciences in education, that during this time he had seen them win almost complete recogni-

* Address of the retiring president of the Botanical Society of America, delivered at Boston, December 28, 1909. Reprinted by permission from *Science*, March 4, 1910.

tion and opportunity, but that he was obliged to confess to some disappointment at the results. He was not referring to the sciences in technical education, for in this field their status is satisfactory, but to their position in general or cultural education. He did not presume, he said, to suggest either an explanation or a remedy, but he submitted the matter to the consideration of his expert audience. These words of this eminent educational observer touched an answering chord in my own thoughts, and since that time I have found, by inquiry among my colleagues, that he voiced a feeling quite general among scientific men themselves. It seems, therefore, to be a fact that the sciences, although dealing in knowledge of matters of the greatest immediate interest, and although concerned with the most elemental of all trainings — that in the correlated use of hand, eye and mind — are still of mediocre efficiency as factors in general education. I propose now to discuss briefly the reasons I have been able to find for this undesirable condition of a part of our scientific affairs, and to suggest with particular reference to our own beloved science, some remedy therefor.

It will help to clarify our problem if we can come to an understanding upon certain points in the general relations of the sciences to education, the first being this — what place ought the sciences to have in education? I think we shall agree that the sciences can never, under any circumstances, hold a place in education nearly as prominent as that of the humanities. Man is not primarily a reasoning but a feeling being. As a philosopher has expressed it, "few men think at all and they but seldom." Hence the great majority of people in most part, and all people in some degree, can best be reached and influenced by studies which appeal primarily to the feelings, that is, by the humanities, while it is only a minority which can best be reached by studies appealing chiefly to the reason — that is, by the sciences and mathematics. But a minority has rights, and those to whom the sciences especially appeal, and to whom therefore they are of the higher cultural value, are just as entitled to efficient instruction in their subjects as are the majority in theirs. The sciences must always hold, from their nature in conjunction with that of hu-

manity, a position quantitatively inferior to that of the humanities, but they are entitled to a qualitative equality of educational rank and opportunity. This they do not yet possess, and it is alike our duty and our interest to see that they shall.

A second point of importance in the general relations of the sciences to education is involved in the fact that the times themselves are a bit out of joint, educationally speaking. This is not a matter of individual opinion, but of well-nigh universal agreement. The recent addresses of our younger college presidents have united in expressing dissatisfaction with the results derived from our superb educational equipment, while the remarkable declaration of principles of the National Educational Association, issued a year and a half ago, recognizes an equivalent condition for the schools. It is a fact that our students as a whole have many hazy impressions but little exact knowledge, are habitually inaccurate even in the three r's and have too little regard for intellectual matters. The cause of it all is obvious enough. Our education, step by step with our modern life, has become luxurized. Its features disagreeable to young people have been sedulously softened, their whims are determinants of educational programs, and the responsibility for learning has been largely shifted from them to their teachers. The wise Mr. Dooley has the modern college president say to the incoming freshman: "What branch iv larnin' wud ye like to have studied f'r ye be our compitint profissors?" and his humor as usual illumines a central kernel of truth. The trouble with our education is this, that it needs more starch; yea, it needs a bit more blood and iron. It ignores the fact that, with the mind as with the body, it is only through effort that strength can be gained, and through responsibility that character can be formed. It is not more work our students need, but work of a kind which does more to inculcate a willingness for effort, and pride in a Spartan devotion to duty — of a kind which enkindles in the heart of youth the precious spark of intellectual ambition. I would not exaggerate the defects of our present-day education. I know they do not go to the vitals, and certainly they are more serious in some places than others. But this granted, there yet remains too great

a deficiency, especially in educational morale. Our colleges are not going to the dogs, but they certainly permit some very queer mongrels to roam at large on the campus.

Now the application of these remarks to our present problem is doubtless sufficiently plain. In an educational system which too much permits inaccuracy of work, indefiniteness of knowledge, avoidance of effort, and whimsical selection of studies — in such a system the sciences, whose essence is care, exactness, persistence and consistency, have not a wholly fair chance. One of the principal reasons, therefore, why the sciences do not loom larger in present-day education is the fault of that education and not of the sciences.

A third point of importance in the educational status of the sciences is involved in the fact that they have not as yet had time to become organized and standardized for their most effective educational use. The humanities have behind them so many generations of experience that they are now measurably standardized throughout, and offer a continuous and suitably-graded training from kindergarten to college. But the sciences as laboratory-taught subjects are not much more than a single generation old, and many of their problems are still unsettled. In the higher grades our teaching is better than in the lower, while, as everybody knows, we are still far from any consistent and continuous system of instruction in nature knowledge in the lower schools. Just here lies a great weakness of scientific education at the present day, for students too often are sent into high school and college not only without the positive advantage of good early training, but even with a prejudice against a kind of activity of which they had little, or too often an unfortunate, experience. This condition is inevitable to the youthfulness, educationally, of the sciences, and will be remedied in time.

The last point I would mention in the educational relations of the sciences to the older subjects is this, that the sciences are under some minor disabilities from which the others are free. These center in the laboratory, and are connected in part with the fact that the laboratory type of study, with its mechanical manipulation, its fixed hours and methods of work, and its absolute re-

quirement of independent observation, is distasteful to the great majority of persons, who, whether by natural inclination or acquired habits, prefer to absorb their knowledge in physical ease, by methods which can be lightened by the wits, and from printed books upon which they can lean for authority. Again, laboratories are expensive, much more expensive than the equipment of the other subjects. This acts as a check to the sciences all along the line, while in poorer communities it is often determinative against their introduction at all.

Now it may seem, at this point, that I have needlessly infringed on your patience and my own allotment of time in thus enumerating such obvious matters, but in truth I have had a good object, which is this: I wish to emphasize that all of these disabilities under which science-teaching now labors, these elements of our problem which are not our own fault and for the most part are beyond our control, and the list of which I have made as long as I could, — all of these taken together go only a very small way towards explaining the deficiency of the sciences in education. This deficiency, I believe, is for the most part our own fault and removable, and it all centers in this, that we are not teaching our subjects properly. And now I have reached the real theme of my present address.

Whenever we are faced by any large problem, we tend to seek its solution in some single great factor. Yet, as the phenomena of our own science so often illustrate, the solution is as likely to be found in the cumulative action of several small causes, and such I believe to be true of the problem before us. These causes are some four in number, of which the first appears to be this — *we are not faithful to the genius of our subject.*

The genius of science consists in exact observation of real things, critical comparison of actual results, and logical testing of the derived conclusions. The educational value of science consists in a training in these things, and our teaching should reflect them. Yet in fact in too great part it does not. For one thing we have joined in the rush to render our subjects popular, a spirit which is one of the pernicious by-products of the elective system under which most of us work. Our subjects being elect-

ive, students will not take them unless they are made attractive ; our success as teachers is largely judged by the number of students we can charm into our courses ; our colleagues stand ready to cry "snap" to any course which grows faster than they can see cause for ; therefore the logical procedure for the teacher is to draw great numbers but keep them complaining of the work, and he is the greatest teacher under this system who can attract so many students that a new building must be provided immediately, while their lamentations over the difficulty of the course are loud enough to reach the ears of all of his colleagues! Now this condition can be attained with quantity, though not with intensity, for most students will not elect a course involving intensive work which they cannot escape, but they are willing to elect one in which the work may be eased by the wits, no matter how copious the irrigation of information may be. Just here indeed is a very fundamental trouble with our education in general. We are teaching our students to gobble when they need to be taught to fletcherize.

Another phase of our treason to the genius of science is found in the belief and practise of some teachers that broad generalizations are the true aim of elementary teaching. I know a recent elementary text-book in which the author laments that "some teachers do not yet understand the importance of imparting to beginners a general rather than a special view point." And I could cite many passages to show a belief of this and some other teachers that subject matter, accuracy in details, and other fundamental verities of science, are not important in comparison with viewpoints and outlooks on life and that sort of thing. In my opinion there can be no greater educational error. There is no training which American youth needs more than that in a power to acquire knowledge accurately and to work details well. Disregard for particulars and a tendency to easy generalities are fundamental faults in American character, and need no cultivation, but, instead, a rigorous correction.

Another phase of our disregard of the genius of science is found in the bad character of some of our elementary teaching. Our plant physiology in some cases is so erroneous that it is

only the general badness of our teaching which saves us from the humiliation of having our errors pointed out by those we are trying to teach. Our elementary experiments ought to be conducted in the spirit of rigid control, just as carefully as in any investigation. The motto in the experimenting recommended by our text-books seems to be, "the easiest way that will give a result in agreement with the book," and we seem not to care whether that result is logically or only accidentally correct. In this spirit is the use of make-shift and clumsy appliances instead of accurate and convenient ones, something which is justifiable only when no better can possibly be had. Such slip-shod and inaccurate ways are not only wasteful of time and effort, but are actually pernicious because they inculcate a wrong habit and ideal of scientific work. I do not mean at all, here or anywhere, that young pupils should be made to study advanced scientific matters or to use technical methods, but simply that the treatment of their subjects according to their grades should be strictly scientific in spirit as far as it goes. Moreover, any attempt to avoid this spirit is the more unfortunate because needless, for as a matter of fact the great majority of young people respect exactness, and really like to be made to do things well. They do not like the process at first, and will avoid it if they can, but they like the result, and if the process be persisted in they come in time also to like that.

In a word the first great need of our science teaching is to make it scientific.

(*To be continued*)

This spring all teachers interested in the preservation of wild flowers ought to read The Passing of the Wild Flowers, a prize essay published by the *Journal of the New York Botanical Garden* last July. The writer, Miss Mary Perle Anderson, shows by actual tests made in the first five grades with one of the very comprehensive prohibitive signs now in use in Bronx Park that these placards are not easily comprehended by children. The conversations with various lawbreakers of all ages and nationalities are interesting and indicate clearly the general thought-

less and usually selfish attitude of so many park visitors; the willfully lawless are estimated at but five to ten per cent. of the offenders.

The parts of President Taft's message most interesting to botanists deal with the control of forests, the conservation of soils, and the irrigation of arid lands. They are reprinted below:

Control of Forests: "The forest reserves of the United States, some 190,000,000 acres in extent, are under the control of the Department of Agriculture, with authority adequate to preserve them and to extend their growth, so far as that may be practicable. The importance of the maintenance of our forests cannot be exaggerated. The possibility of a scientific treatment of forests so that they shall be made to yield a large return in timber, without really reducing the supply, has been demonstrated in other countries, and we should work toward the standard set by them, as far as their methods are applicable to our conditions.

"Upward of 400,000,000 acres of forest land in this country are in private ownership, but only 3 per cent. of it is being treated scientifically and with a view to the maintenance of the forests. The part played by the forests in the equalization of the supply of water on watersheds is a matter of discussion and dispute, but the general benefit to be derived by the public from the extension of forest lands on watersheds and the promotion of the growth of trees in places that are now denuded and that once had great flourishing forests goes without saying. The control to be exercised over private owners in their treatment of the forests which they own is a matter for state and not national regulation, because there is nothing in the Constitution that authorizes the federal government to exercise any control over forests within a state, unless the forests are owned in a proprietary way by the federal government.

It has been proposed, and a bill for the purpose passed the lower House in the last Congress, that the national government appropriate a certain amount each year out of the receipts from the forestry business of the government, to institute reforestation

at the sources of certain navigable streams to be selected by the Geological Survey with a view to determining the practicability of thus improving and protecting the streams for federal purposes. I think a moderate expenditure for each year for this purpose for a period of five or ten years would be of the utmost benefit in the development of our forestry system."

Conservation of Soils: "In considering the conservation of the natural resources of the country, the feature that transcends all others, including woods, waters, minerals, is the soil of the country. It is incumbent upon the government to foster by all available means the resources of the country that produce the food of the people. To this end the conservation of the soils of the country should be cared for with all means at the government's disposal. Their productive powers should have the attention of our scientists, that we may conserve the new soils, improve the old soils, drain wet soils, ditch swamp soils, levee river overflow soils, grow trees on thin soils, pasture hillside soils, rotate crops on all soils, discover methods for cropping dry land soils, find grasses and legumes for all soils, feed grains and mill feeds on the farms where they originate, that the soils from which they come may be enriched.

"A work of the utmost importance to inform and instruct the public on this chief branch of the conservation of our resources is being carried on successfully in the Department of Agriculture; but it ought not to escape public attention that state action in addition to that of the Department of Agriculture (as, for instance, in the drainage of swamp lands) is essential to the best treatment of the soils in the manner above indicated.

"The act by which, in semi-arid parts of the public domain, the area of the homestead has been enlarged from 160 to 320 acres has resulted most beneficially in the extension of "dry farming", and in the demonstration which has been made of the possibility, through a variation in the character and mode of culture, of raising substantial crops without the presence of such a supply of water as has been heretofore thought to be necessary for agriculture."

Arid Land Irrigation: "But there are millions of acres of com-

pletely arid land in the public domain which, by the establishment of reservoirs for the storing of water and the irrigation of the lands, may be made much more fruitful and productive than the best lands in a climate where the moisture comes from the clouds. Congress recognized the importance of this method of artificial distribution of water on the arid lands by the passage of the reclamation act. The proceeds of the public lands create the fund to build the works needed to store and furnish the necessary water * * * . It would appear that over thirty projects have been undertaken, and that a few of these are likely to be unsuccessful because of lack of water, or for other reasons, but generally the work which has been done has been well done, and many important engineering problems have been met and solved.'

NEWS ITEMS

At Leland Stanford George J. Pierce, associate professor of botany, has been advanced to professor.

Willis T. Pope, professor of botany in the College of Hawaii, has been appointed superintendent of public instruction for Hawaii, his position will be filled by Vaughan MacCaughey (Cornell, '08).

At the University of Missouri, assistant professor George M. Reed has been appointed assistant professor in charge of the department for the coming year. Dr. E. J. Durand of Cornell University has been appointed assistant professor of botany. The professorship in botany, made vacant by the resignation of Professor C. Stuart Gager, will not be filled for the coming year.

The illustrated public lectures at the New York Botanical Garden, which were begun in April, will continue until early in July. The coming lectures are "An Expedition to the Panama Canal Zone" by Dr. M. A. Howe, May 28; "Summer Flowers" by Dr. N. L. Britton, June 4; "The Rose and Its History" by Mr. George V. Nash, June 11; "The Native Trees of the Hudson Valley" by Mr. Norman Taylor, June 18; "The Extinct Flora of New York City and Vicinity" by Dr. Arthur Hollick, June 25; and "The Fungous Diseases of Shade Trees" by Dr. W. A. Murrill, July 2.